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and upon the *hypothesis* of the node of the ring-plane on the ecliptic passing through the Sun's centre at either of these dates, the value of i being taken as on October 30^d 12^h, we shall find for the longitude of the node corresponding to

October 30^d 0^h.....168° 3' 18''·1.

October 31^d 0^h.....168° 5' 16''·2.

from which it will appear that the value given by the formula of Bessel as corrected corresponds to October 30^d 11^h·75.

In conclusion, I may say that the most probable reasons for my not having seen any trace of the rings, October 30^d 18^h, are (1) that I observed too short a time before sunrise, (2) that definition that morning was not nearly so good as on the two days previous, fewer belts being seen on the planet. The observations of Mr. Barnard and Mr. Comstock seem to have been made 81^m and 76^m before sunrise to them.

Murston Rectory, Sittingbourne :
1892 May 7.

Negatives of Jupiter, made with the Great Telescope of the Lick Observatory during 1891. By Edward S. Holden and W. W. Campbell.

We have the honour to present to the Royal Astronomical Society, in the name of the Lick Observatory, a series of negatives of *Jupiter*, made with the Great Telescope during the year 1891, in continuation of the work of 1890. A list of the negatives is given below. The following memoranda should accompany them. The negatives are all taken on 8 × 10 plates—Seed, No. 26. The enlargements are directly made, in the telescope, by means of an ordinary camera objective of 2 inches aperture and 14 inches focus, furnished us by Alvan Clark, Jun., for the purpose. This lens is used so as to give an enlargement of a little over eight diameters—that is, the negatives are affected by the wind blowing on the instrument (and by other accidental disturbances) as if they were taken in the principal focus of a telescope 400 feet long.

The enlargement employed is too great, and the enlarging lens itself is not entirely satisfactory. We hope to procure a new lens before the next opposition, which shall give better images and less magnifying.

All the exposures have been made by the two observers working together, and all the plates have been developed by Mr. Campbell. Each plate is intended to be marked with the date, the observers' initials, the setting of the enlarging lens in its tube (5·06), the setting of the negative plate on the focusing screw (1·0), the Pacific standard times of the beginning and

ending of each exposure, with notes on the weather. In these notes the words "Windy" and "Very windy" are far too common. The exposures varied between eight and twelve seconds, ten seconds being the usual one.

Several negatives were made each night, and the best have been selected and are preserved for reference at the Lick Observatory. All the other plates were called "duplicates," and as full a set of these as possible has been made up for presentation to the Royal Astronomical Society, irrespective of the excellence of the individual pictures. We desire to call attention to this fact, as our object has been to enable others to have all the data available for a study of the planet, and not at all to exhibit only the best results of our work. Even the poorest pictures have a statistical value. We have satisfied ourselves that when the atmospheric conditions are good (and especially when no wind is blowing) we can always produce results of uniform excellence. The number of pictures made in 1891 is smaller than it ordinarily will be, because the telescope was in use for making visual observations on the forms and the rotations of *Jupiter's* satellites on many of the nights which would otherwise have been devoted to photographic work.

Mount Hamilton:
1891 December 31.

List of Negatives of Jupiter.

| Date 1891. | Name of Plate. | Number of Images on the Plate. | Approximate P.S.T. | | Remarks. |
|---------------|-------------------|-----------------------------------|-----------------------|----|-------------|
| | | | h | m | |
| Aug. 25 | A ² | 4 | 12 | 29 | |
| 26 | B ² | 4 | 11 | 48 | |
| Sept. 28 | G ² | 3 | 10 | 34 | Very windy. |
| 28 | F ² | 3 | 10 | 43 | Very windy. |
| 28 | C ² | 3 | 11 | 54 | Very windy. |
| Oct. 11 | H ² | 3 | 9 | 0 | |
| 11 | G ¹ | 3 | 10 | 8 | |
| 11 | I ² | 3 | 11 | 7 | Windy. |
| 12 | B ² | 3 | 8 | 57 | Windy. |
| 25 | A ² | 3 | 8 | 56 | Windy. |
| 25 | H ¹ | 3 | 9 | 40 | Windy. |
| 25 | I ¹ | 3 | 11 | 17 | Windy. |

Photographic Search for a Planet beyond the Orbit of Neptune.
By Isaac Roberts, F.R.S.

The hypothesis that one or more planets exist beyond the orbit of *Neptune* has been long entertained by astronomers, and Professor Forbes, in a remarkable paper on "Comets and ultra-Neptunian Planets," which he read before the Royal Society of Edinburgh at the beginning of the year 1880, predicted with considerable confidence that one or two such planets exist, and in the paper referred to he gave very fully his reasons.

The prediction was based upon the recorded positions of the aphelia of a number of comets. He said,* "That there could be no longer a doubt but that two planets revolve in orbits external to that of *Neptune*, one about 100 times, the other about 300 times the distance of the Earth from the Sun."

In 1887, November, I wrote to Professor Forbes to ask him if he had further considered the hypothesis concerning the supposed planets, and that I was prepared to make a search for them by photographic methods. In his reply he stated that the present position of one of the hypothetical planets is $11^{\text{h}} 48^{\text{m}}$ R.A. and 3° N. Declination, and he believed that a range of 5° each way in R.A. and of 2° or 3° in Declination ought to find the planet if it is there. The motion of the planet he computed at one degree in 2.96 years.

I thereupon commenced the search, but soon found that the climate of Maghull was so unfavourable for celestial photographic work of this character that my task was nearly hopeless; but since the removal of my observatory to Crowborough I resumed the search under conditions sufficiently favourable to complete the work, which was conducted on the following plan:—

A chart was made of the region indicated by Professor Forbes between R.A. $11^{\text{h}} 24^{\text{m}}$ and R.A. $12^{\text{h}} 12^{\text{m}}$ with Declination $0^{\circ} 0'$ to $6^{\circ} 0'$ North. This region was covered by eighteen photographic plates, each of more than four square degrees in area, and allowed of sufficient overlap to show a number of the same stars on two or more contiguous plates. Two sets of photo-plates of the region were taken with an interval of not less than seven days between the exposures, which were of ninety minutes duration, and the dual photographs were subsequently compared three times over by superposition, in order to see if any star appeared on one plate which was not on the other, or to see if change in the position of any star had taken place in the interval between the dual exposures. In this way the whole of the plates covering the region were very carefully examined, and it now only remains for me to report that no planet of greater brightness than a star of the 15th magnitude

* *Memoir*, p. 3.